

## **Re-engineering the Systems Engineering Process at JPL**

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In response to changing mission profiles for future missions, JPL is re-engineering its project design process. At the core of this new process are the Project Design Center (PDC), Flight System Testbed (FST), and Simulated Mission Operations Control Center (SMOCC) which are facilities aimed at strengthening the effectiveness of system engineering activities at JPL.

The PDC is a computer aided engineering facility for developing new mission concepts and performing system design level trades. New practices, such as "design-to-cost" and concurrent engineering of flight and ground systems, are the cornerstones of the new mission design process. An institutional investment has been made to construct a facility that is enabling for proposal teams, advanced studies, and pre-project and project teams.

The FST is a rapid prototyping spacecraft development facility focused on early definition and evolutionary development of mission end-to-end information systems (EEIS). An institutional investment has been made in developing spacecraft prototypes and evaluating new technologies that form a basis for inheritance for new projects. The return on this investment will accrue from rapid project startup and lower flight system development and integration costs.

The SMOCC is a ground system testbed facility focused on validating new mission operations concepts and evaluating new ground system technology in a end-to-end information system environment. An institutional investment has been made in developing multi-mission ground system tools and services to give new projects a quick start and lower ground system development costs.

New projects will place teams in all three facilities simultaneously. In the PDC, the team will perform system trades to identify mission architectures, potential science return, and cost effective implementation approaches. The selected avionics architectures are prototype and evaluated in the FST, and insights gained from this activity are fed back into the design efforts in the PDC. Similarly, ground operations concepts are prototype in the SMOCC, using the spacecraft prototype in the FST for closed loop simulation. Analytically computable performance measures, such as pointing stability or power consumption, are modeled in the PDC activities, while performances that must be gathered by more direct measurement, such as flight processor loading or adequate staffing to respond to anomalies, are harvested from a hardware-in-the-loop simulation in the FST and simulated operations in the SMOCC.

The PDC, FST, and SMOCC can be seen as vital systems engineering tools that dramatically reduce mission costs and development times. This paper gives an overview of these facilities, as well as the mission development process they embody.

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